

REMARKS

The specification has been amended to correct errors of a typographical and grammatical nature. Due to the excessive corrections thereto, applicants submit herewith a Substitute Specification, along with a marked-up copy of the original specification for the Examiner's convenience. Applicants submit that the substitute specification includes no new matter. Therefore, entry of the Substitute Specification is respectfully requested.

The claims and abstract have also been amended to more clearly describe the features of the present invention, and a copy of the marked up claims and abstract is also enclosed.

Entry of the preliminary amendments and examination of the application is respectfully requested.

To the extent necessary, applicant's petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 01-2135 (520.40496X00) and please credit any excess fees to such deposit account.

Respectfully submitted,

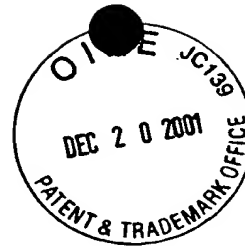


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SPECIFICATION

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TITLE OF THE INVENTION

DISC DRIVING APPARATUS

BACKGROUND OF THE INVENTION

5 The present invention relates to a disc driving apparatus equipped with an optical pickup for reproducing or reproducing/recording [of] information on an optical disc [r], and, in particular, ^{the invention} it relates to ^a [the] disc driving apparatus [r] being ^{used as a} suitable for so-called [a] CD-ROM drive, a DVD-ROM drive, and a DVD-RAM drive, etc.

15 (As ^A [a] laser light generation device and an optical disc read-out/write-in apparatus equipped ^{therewith} [with it, according to] conventional art, as was ^{have been} described in, for example, Japanese Patent Laying-Open No. Hei 10-283650 (1998) (conventional art 1) [r], there] ^{is} [is known] such a device, [in which] a thermally conductive sheet is disposed between a first heat radiation member and a second heat radiation member, wherein ^{the} [a contacting] ^{of contact} area is increased between the first heat radiation member and the second heat radiation member, ^{compared} [comparing] to the case where ⁱⁿ [the] both members are ^{each other} contact ^{which is} with ^{heat generating element, such as a} a semiconductor laser element ^{flows} [as a heat-generating element], into the second heat radiation member effectively, so as to cool down the semiconductor laser element with high efficiency.

25 Also, [as] an optical pickup [r] according to the conventional [art, as] was described in, for example, Japanese Patent Laying-Open No. Hei 6-111357 (1994) (conventional art 2) [r] there is also known]. ^{by} such an optical pickup [with] using a prism made of plastic therein,

(for providing) an optical pickup^{is provided} that can detect an excellent signal without^{causing} shifting of ^{the} optical axis within the plastic prism due to change of temperature^{in this regard,} wherein a spacer^{purpose} for use of heat insulation is ^{placed} between an optical system^{forming} constructing the optical pickup and a silicon substrate^{appearing} on which a laser diode^a is provided for emitting a laser light^{beam} into the optical system, so as to form a layer of ^{an} air having low thermal conductivity, thereby enabling radiation of heat ^{conducting} from the laser diode into the silicon substrate.

^{the above-described} However, in ^{concerning} those conventional arts 1 and 2, there is no disclosure ^{of} about deterioration on the lifetime of parts or elements, erroneous operation, or a decrease in^{the} reproducing/recording accuracy, accompanying ^{with} a non-uniform local temperature distribution, due to thermal interference between ^{the} adjacent^{ly} disposed^{ed} ~~of the~~ heat generating elements and/or heat generation of ^{the} heat-generating element^s. Therefore, there is a possibility that, in a case where plural numbers of heat-generating elements are disposed^{at} neighboring ^{locations relatively close to} each other, due to the thermal interference between the heat-generating elements, elements having^a small heat generation amount and/or ^{elements} ~~ones~~ of low heat-resistance or endurance are affected with the thermal influences^{provided} by other heat-generating elements, thereby causing ^{the} deterioration on the lifetime of elements, ^{the} erroneous operation, and/or ^{the} decrease in^{the} reproducing/recording accuracy.

25 Namely, in general, within a disc drive or apparatus equipped with ^{an} the optical pickup, there are mounted a laser diode^{which generates} (generating) a heat when it ^{performs a} conducts recording/reproduction^{ing} operation, a laser driver circuit board, a high frequency module, and plural numbers of parts or elements, such as ^a a driver coil for use in an objective lens driver, etc., to be connected thermally, in a pickup housing made of metal, and heat generation of those heat-generating elements causes ^{the} local non-uniform temperature distribution within the pickup housing, thereby causing ^{the} thermal interference between those heat-generating elements. In particular,

^{respect to}
[accompanying] with multi-functions of the disc drive apparatus,
various disc drive apparatuses ^{have been} [are] developed ^{which are} [being] equipped with^a
CD-R/RW function for ^{recording} [recoding] information on the disc, ^a DVD-R/RW
function for a disc of much larger recording capacity, and/or^a
5 DVD-RAM function, etc. In those disc drive apparatuses, the
detection light (i.e., a laser light beam) emitted from the laser
diode provided within the optical pickup ^{typically has} [comes to be] a very large
[in the] output [thereof], and also a large number of heat-generating
elements must be disposed ^{in close proximity} [neighboring] with each other [closely],
10 due to a demand ^{for reduction in the size} [of small-sizing] thereof. Because of those
heat-generating elements, the following problems are ^{needed} [caused] within
the optical pickup:

(1) Thermal interference due to the ^{close} [neighboring] disposition
of the heat-generating elements;

15 (2) Thermal deformation due to ^a [the] locally non-uniform
temperature distribution;

(3) ^A [The] deterioration ^{of} [on] the lifetime of elements due to
[the] heat; and

(4) ^A [The] local rise ⁱⁿ [up of] temperature [within an] inside of
20 the apparatus due to heat radiation from the elements functioning
as ^a heat source, and erroneous operation or malfunction in a circuit
system.

SUMMARY OF THE INVENTION

An object ^{of} [according to] the present invention [is] to provide
25 a disc driving apparatus, wherein [the] thermal interference is
reduced between [the] heat-generating elements ^{which are} disposed ^{in close proximity} [neighboring]
with each other, in particular, in the optical pickup, so as to
[achieve the protection ^{protect} of] the heat-generating elements from
deterioration ^{leading to reduction in} [on] the lifetime thereof, thereby ^{providing a disc driving apparatus having a} [having] high
30 reliability.

Another object^{of} [according to] the present invention[,] is to provide a disc driving apparatus, wherein [the] thermal interference is reduced between [the] heat-generating elements disposed ^{in close proximity} [neighboring] with each other, in particular, in the optical pickup, so as to enable protection of the heat-generating elements from deterioration ^{leading to reduction in} [on] the lifetime thereof, and ^{in which} a shift of the detection light is made small, as well, so as to improve the accuracy in reproducing or reproducing/recording, thereby ^{providing a disc driving apparatus} having high reliability and ^{which is} also [being] able to achieve reproducing or reproducing/recording of information with high definition.

A further [other] object^{of} [according to] the present invention[,] is to provide a disc driving apparatus, wherein [the] thermal interference is reduced between the heat-generating elements disposed ^{in close proximity} [neighboring] with each other, in particular, in the optical pickup, so as to enable protection of the heat-generating elements from deterioration ^{leading to reduction in} [on] the lifetime thereof, and ^{in which the} strength or rigidity of a pickup housing is secured, as well, so as to improve the accuracy in reproducing or reproducing/recording, thereby ^{providing a disc driving apparatus} having high reliability and ^{which is} also [being] able to achieve reproducing or reproducing/recording of information with high definition.

First, according to the present invention, for accomplishing the above-mentioned objects, there is provided a disc driving apparatus, comprising: a housing ^{for} [of] a disc drive; a rotation mechanism ^{accommodated} [being received] within said housing [and] for rotating a disc; ^{and} an optical pickup mechanism ^{disposed} [being received] within said housing [and] for reproducing or reproducing/recording [of] information on the disc, wherein: said ^{the} optical pickup mechanism has an optical pickup and a driving mechanism for driving said optical pickup ^a in radial direction of said disc; said ^{the} optical pickup comprises a pickup housing made of metal, in which are mounted a laser diode emitting a detection light ^{beam} for reproducing or recording [the] information on said disc, a laser driver circuit board for controlling said laser diode, an objective lens driver for guiding the detection light ^{beam} emitted from ^{the laser diode} to a predetermined

position on said disc and for guiding reflection light from said disc onto an optical detector, optical parts, including a lens, a prism, a mirror therein, and an optical detector for detecting said detection light; and said pickup housing mounts said laser diode and said laser driver circuit board ^{are mounted} with connecting them ^{to} thermally ^{in contact with said pickup housing, so as to be} disposed ^{to} adjacent ^{to} each other, while providing a thermal separation portion for thermally separating ^{between} said laser diode and said laser driver circuit board.

Second, according to the present invention, for
10 accomplishing the above-mentioned objects, there is also provided a disc driving apparatus, comprising: a housing ^{accommodates} of a disc drive; a rotation mechanism ^{and} being received within said housing ^{disposed} and for rotating a disc; an optical pickup mechanism ^{disposed} being received within said housing ^{and} for reproducing or reproducing/recording ^{of} information on the disc, wherein: said ^{the} optical pickup mechanism has an optical pickup and a driving mechanism for driving said optical pickup ^a in radial direction of said disc; said ^{the} optical pickup comprises a pickup housing made of metal, in which are mounted a laser diode for emitting a detection light ^{beam} for ⁱⁿ the use ^{of} a CD system, so as to reproduce or record ^{the} information on said disc, a laser diode for emitting a detection light ^{beam} for ⁱⁿ the use ^{of} a DVD system, so as to reproduce or record ^{the} information on said disc, a laser driver circuit board for controlling said laser diode for ⁱⁿ the use ^{of} the CD system, an objective lens driver ^{beam} for guiding the detection light emitted from to a predetermined position on said disc and for guiding reflection light from said disc onto an optical detector, optical parts, including a lens, a prism, a mirror therein, and an optical detector for detecting said detection light; and said pickup housing mounts said ^{the} laser diode for ^{with a} the use ^{of} CD, ^{to} said laser diode for the use ^{with a} of DVD, ^{the} said laser driver circuit board and ^{are mounted} said objective lens driver ^{in contact with said pickup housing so as to be} with ^{connecting them} thermally, wherein said laser diode for the use ^{of} CD and said laser driver circuit board are ^{to} disposed ⁱⁿ adjacent ^{to} each other, while providing a thermal separation portion for
35 thermally separating ^{between} a side of said laser diodes for ^{the}

with a
use of CD and DVD and a side of said laser driver circuit board
and said objective lens driver.

Third, according to the present invention, for
accomplishing the above-mentioned object, there is further
5 provided a disc driving apparatus, comprising: a housing of a disc
drive; a rotation mechanism ^{accommodated} being received within said housing
and for rotating a disc; ^{disposed} an optical pickup mechanism being received
within said housing and for reproducing or reproducing/recording
of information on the disc, wherein: said ^{the} optical pickup mechanism
10 has an optical pickup and a driving mechanism for driving said
optical pickup in ^a radial direction of said disc; said ^{the} optical pickup
comprises a pickup housing made of metal, in which are mounted
a laser diode for emitting a detection light ^{beam} for (the) use of CD,
so as to reproduce or record (the) information on said disc, a laser
15 diode for emitting a detection light ^{beam} for (the) use of DVD, so as
to reproduce or record (the) information on said disc, a laser driver
circuit board for controlling said laser diode for (the) use of CD,
an objective lens driver for guiding the detection light ^{beam} emitted
to a predetermined position on said disc and for guiding reflection
20 light from said disc onto an optical detector, optical parts,
including a lens, a prism, a mirror therein, and an optical detector
for detecting said detection light; and said ^{the} pickup housing is
defined by a sidewall formed all around ^{the periphery} thereof and a bottom wall,
and said laser diodes for (the) use of CD and DVD ^{with a} said laser driver
25 [circuit board and said objective lens driver are mounted therein]
(with thermally connecting thereamong), wherein said laser diode
for (the) use of CD and said laser driver circuit board ^{are mounted thermally in contact with said pickup housing and} are disposed
(in) adjacent ^{to} each other, while providing a thermal separation
portion for thermally separating between a side of said laser diodes
30 for (the) use of CD and DVD and a side of said laser driver circuit
board and said objective lens driver.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded perspective view of a disc driving

apparatus, according to a first embodiment of the present invention;

5 Figs. 2(a) and 2(b) show a plane view and a cross-section^a view of an optical pickup in the disc driving apparatus (mentioned above);

Figs. 3(a) and 3(b) show a plane view and a cross-section^a view of an optical pickup in the disc driving apparatus, according to a second embodiment of the present invention; and

10 Figs. 4(a) to 4(d) are ^{diagrams illustrating} (views for explaining) the condition of thermal flow-through in the disc driving apparatus (mentioned above).

DESCRIPTION OF PREFERRED EMBODIMENTS

Hereinafter, embodiments according to the present invention will be fully explained ^{with reference} (by referring) to the attached drawings. 15 However, ^{the} same reference numerals indicate the same elements or equivalents thereof in each of ^{the} (embodiments).

First, ^{an} explanation will be given (on) ^a a first embodiment according to the present invention ^{with reference} (by referring) to Figs. 1 to 3.

20 First of all, the ^{overall} (total) structure of the disc driving apparatus according to the present embodiment and the operation thereof will be explained ^{with reference} (by referring) to Fig. 1. (This Fig. 1) ^{which} is an exploded perspective view of the disc driving apparatus according to the first embodiment of the present invention.

25 A disc driving apparatus 40, being a DVD-ROM apparatus corresponding ^{to a device} (the) CD-R/RW, comprises a disc driver housing 41 (as) (the structure thereof), a disc loading mechanism for carrying a disc 1 into ^{and out} (an inside) of the disc driver housing 41 (or out from)

[the disc driver housing 41], and a reproducing/recording mechanism for reproducing/recording information on the disc 1. This disc driving apparatus 40 is installed, for example, within a computer apparatus, to be used therein. Further, the present invention is applicable to [within a certain extend of the structure, being common] (or corresponding to) ^{a device} such as a CD-ROM drive, a DVD-RAM drive, etc.

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The disc driver housing 41 ^{as seen in} comprises: sidewalls 42 in a rectangular shape ^{the space defined by the} [on a plane view (thereof)], a mechanical base 7 formed within ^(this) sidewalls 42, a top cover for covering over an upper surface opening of the sidewalls 42, and a bottom cover 9 for covering a lower surface opening of the sidewalls 42, (whereby) ^{thickly} defining an inner ^{space} [space being] almost closed [with them], so as to store elements ^{capable of heat} [accompanying heat-generation therein. Furthermore, since the disc driver housing 41 ^{elements of the} is thin ^{are} (in the thickness thereof), ^{and the inner space for accomodating a large number of} ^{heat generating elements is small due to a} (upon the) demand ^{for down} [of small] sizing of the apparatus, (to be small in) [the inner space, therefore accompanying with the large capacity] [of the heat-generating elements, the thermal conditions ^{under which} (require) (for) the elements ^{are} stored, ^{becomes very severe} (comes to be severe) or strict. And, in a front panel 10 ^{which represents} [constructing] a front surface of the sidewalls 42, ^{the disc driver housing formed by} there is ^{allowing} [formed] a transportation or access opening 10a for [carrying out/in] a disc tray 11 therethrough.

The disc loading mechanism comprises: the disc tray 11, including a mounting portion 11a for mounting ^a [the] disc thereon, a transportation or access driver mechanism for carrying the disc tray 11 into the disc driver housing 41 through the access opening 10a, so as to mount ^{the disc on} a spindle motor 2 [on it], a disc clamber 3 for fixing the disc 1, ^{onto} [being mounted with the spindle motor thereon], ^(to) a turntable of the spindle motor 2, and an up-down driver mechanism for moving a unit mechanical chassis 5, so as to fix the spindle motor 2 by means of ^{the} [a] disc clamber 3. The access driver mechanism and the up-down driver mechanism ^{are constituted by} [is made up with] a loading motor, a gear for transmitting driving force of a motor, and a driving force transmitting member, etc. Also, the disc clamber 3 is attached

^{to}
(on) the top cover 8 at a predetermined ^{position} [portion] thereof.

The reproducing/recording mechanism comprises (:) a rotation driver mechanism for rotating the disc 1, ^{and} an optical pickup mechanism for performing reproducing/recording of information on the rotating disc 1. In more detail ^{the} (thereof), it comprises the unit mechanical chassis 5, a unit holder, the spindle motor 2 mounted on the unit mechanical chassis 5, the optical pickup 4 mounted on the mechanical chassis 5, and (a) disc clamber 3 attached on the top cover 8. Further, the disc 1 is an information recording medium ^{having} (in) a disc-like shape (thereof).

The unit mechanical chassis 5 is formed in about a rectangular shape on the top plane view thereof, and ^{it} is attached on the unit holder (not shown in the figure) at ^{each of the four} (every) corner thereof through elastic members ^{respectively} 6a-6d. Further, the unit holder is inserted into ^{so as} the mechanical base 7, to be connected therewith. The elastic members 6a-6d are provided for the purpose of attenuation of vibration and/or shock transmitted from (an) outside of the apparatus to the unit mechanical chassis 5. And, the spindle motor 2 has a turn table for mounting the disc 1 thereon, and ^{it} rotates the disc 1 at ^a high revolution speed while holding it, together with the disc clamber 3, for the purpose of (the) reproducing/recording ^{on the disc} (thereof). The disc clamber 3 ^{is} attached (on) ^{to} the top cover 8 at ^a (the) position just above the spindle motor 2.

Also, the optical pickup mechanism comprises the optical pickup 4 for reproducing information on the disc 1, which is mounted on the spindle motor, and for recording information thereon, and a radial direction driver mechanism for shifting or moving that optical pickup 4 in ~~the~~ the radial direction of the disc 1.

Herein, ^{an} explanation will be given (on) ^{of} the total operation of such ^a (the) disc driving apparatus 40. The operation of the disc driving apparatus 40 is made up ^{of} with ^{is carried} a disc loading operation (of) ⁱⁿ which a (transporting the) disc 1 into the disc drive housing 41, so as to

bring the disc 1 into a reproducible or recordable ^{position} condition thereof, and a reproducing/recording operation for performing (the) reproducing/recording of the disc 1 which ^{has been} ^{therein} loaded ^{into}.

The disc loading operation will be explained. First, the access driver mechanism of the disc loading mechanism is actuated, ^{so as} ^{cancel} (thereby) to (make) the disc tray 11 ^{to move out through} projecting out from the access opening 10a (in the condition shown in (the) Fig. 1) and, after the disc 1 is mounted on the mounting portion 11a, the access driver mechanism is actuated ^() again ^() to carry the disc tray 11 into (an) ^(inside of) the disc drive housing 41, thereby mounting it on the turn table of the spindle motor 2. Next, for fixing it by means of the disc clumper 3 which is provided on the surface of the top cover 8, opposing (to) the disc 1, the spindle motor 2, the optical pickup 4, and the unit mechanical chassis 5 holding those ^{elements} thereon are elevated by means of the up-down driver mechanism, as one unit.

^{In} (Explaining) the reproducing/recording operation, under the condition that the disc 1 is loaded into the disc drive housing 41 ^{and is} ^{on} fixed (with) the spindle motor 2, the spindle motor 2 rotates at ^(the) ^{predetermined} ^(revolution) speed, thereby to rotate the disc 1. Under this condition, the reproducing and recording of information ^(on the information) on the disc ^{is carried out} by shifting or moving the optical pickup 4 provided on the unit mechanical chassis 5 in the radial direction of the disc 1.

Next, ^{an} explanation will be given ^{of} ^{with reference} to the details of the optical pickup 4 (mentioned above, by referring) to Figs. 2(a) and 2(b). (The) Figs. 2(a) and 2(b) show a plane view of the optical pickup in the disc driving apparatus (shown in the) ^{of} Fig. 1 and (the) ^{cross-section} ^{view thereof} ^{respectively}. Further, (the Fig. 2(a) is the plane) ^{view, while the} Fig. 2(b) ^{is a} ^{taken along the line A-A} cross-section ^{view} in (the) Fig. 2(a).

The optical pickup 4 comprises a pickup housing 24 for mounting each ^{of the} elements [of the parts] which are necessary for the

reproducing/recording^{operations}. This pickup housing 24 of a box type is made of^a metal material having good thermal conductivity, such as aluminum, magnesium, zinc, etc., and is made up (with) sidewalls 24a and a bottom wall 24b, to be formed in about a trapezoidal shape, ^{as seen} in the plane view thereof. On the sidewall 24a at one side (i.e., ^{on} in the upper side in ^{the} Figs. 2(a) and 2(b)), is formed an opening 24c, through which a guide bar 21 penetrates, and two (2) slide bearings 22 are inserted with pressure into ^{respectively} (both) end portions (within) this opening 24c. Also, on the sidewall 24a at the other side (i.e., ^{on} in the lower side in ^{the} Figs. 2(a) and 2(b)), ^{there} is formed a bearing 23 therewith as a unit, ^{which} (while) project^s therefrom. And, ^{the pickup housing 24 by way of} the guide bar 21 extend^{ing} ^{on} in both sides, for axially supporting the bearings 22, and the guide bar 21 extending in both sides for axially supporting the bearing 23 ^{construction} (are provided on both) side of the pickup housing 24. With this, the pickup housing 24 is movable in the radial direction of the disc 1 (in the horizontal direction, ^{as seen} in ^{the} Figs. 2(a) and 2(b)), thereby being supported, ^{so as to be} freely slidable with a guiding axis of the guide bar 21.

Within ^{the} an inside of the pickup housing 24, are ^{various} provided parts or elements, such as, two (2) detector systems for ^{with} the use of both CD and DVD, respectively. Namely, the pickup housing 24 comprises: a laser diode 27 (of wavelength: 780 nm) for ^{with a} the use of CD, a laser diode 28 (of wavelength: 650 nm) for ^{with a} the use of DVD, both ^{serving} as the detection light source, a prism 31 for guiding those detection light^{beams} upon the disc 1, a mirror 30, a collimator^a lens 32, a common photo-detector 34, for ^{with} the use both of CD and DVD, for detecting the reflection light from the disc 1, a driver circuit board 29 for the laser diode 27 ^{for the use of CD (hereinafter, only "for CD")}, a driver circuit for the laser diode 28 ^{for the use of DVD (hereinafter, only "for DVD")}, a high frequency module, and a front monitor 35, [etc.] as well as an objective lens driver 26, which is equipped with an objective lens for determining the detection light on the disc 1 at a predetermined position accurately, etc.

^{as to the}
[For the purpose of] dispositions of those parts or elements,

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^{use} CD and the laser diode 28 for DVD, ^{use} thermally, and this is constructed with a slit portion and a recessed gutter formed in the pickup housing 24 and ^{separation} a heat separation member 25.

/ The heat separation member 25 is made of material, being ^{having a} smaller (in) thermal conductivity (thereof) than that of the pickup housing 24, such as a PPC resin (polyphenylene sulfide), polycarbonate, polystyrene, etc., and it is so provided that it separates the laser diode 27 for ^{use} CD, thermally, from the pickup housing 24, which is positioned between the laser diode 27 for ^{use} CD and the laser driver circuit board 29. In case of taking the strength or rigidity of the pickup housing 24 into the consideration, it is preferable to put in or mix a material (of), such as glass filler, etc., into the ^{material} thereof, for ^{increasing} (rising up) the rigidity thereof. This heat separation member 25 is filled up ^{within an} inside of the slit, which divides the bottom wall 24b into two, ^{in disposed} (2), and within the recessed gutter on the lower surface side of the sidewall 24a on an extended line from this slit portion, so as to be formed as one unit. The recessed gutter of this sidewall 24a is located in the middle between the laser diode 27 for ^{use} CD, and the laser driver circuit board 29. In this manner, the heat separation member 25 is provided within the pickup housing 24, for the purpose of ^{providing} heat separation between the laser diode 27 for ^{use} CD, which emits a large amount of heat (generation) when recording information on ^a the disc ^{in a} corresponding to the ^{device} CD-R/RW, and the laser driver circuit board 29 ^{to support} for the use of ^{operations} CD within the housing. In other words, the heat separation portion 25 is provided so that the pickup housing 24 is divided into two ^{parts} (2), thermally, between the laser diode 27 for ^{use} CD, and the laser driver circuit board 29 ^{to support} for the use of ^{operations} CD.

30 Also, the heat separation member 25 is provided almost ^{all} along (over) the entire width in both directions of the pickup housing 24, so as to separate the laser driver circuit board 29 and the objective lens driver 26 from the laser diode 27 for ^{use} CD and the laser diode 28 for DVD, thermally. And, the prism 31, the mirror

30 and the optical detector 34 are positioned ^{on} ~~in~~ the same side ^{use} ~~to~~ the laser diode 27 for CD and the laser diode 28 for DVD.

As ~~was~~ mentioned ~~in the~~ above, the pickup housing 24 is made of ^{such as} ~~such the~~ metal material, aluminum, magnesium, zinc, etc., and the thermal conductivity is about 200 kcal/mh°C for aluminum, about 150 kcal/mh°C for magnesium, about 100 kcal/mh°C for zinc; therefore, the heat generated from the heat-generating elements 26 to 29 is preferably conducted to the pickup housing 24 ^{and is} ~~to be~~ radiated from the surface of the pickup housing 24. ^{On the other hand} ~~In this case~~, the thermal conductivity of the heat separation member 25 is about 0.2 kcal/mh°C since it is made of ^a ~~the~~ resin material. ^{Thus} ~~With this~~, putting the heat separation member 25 between them ^{makes it possible} ~~enables~~ to ^{reduce to} ~~make as~~ about 0.001 times ^{as} ~~small~~ ~~as~~ the thermal flow-through within the pickup housing 24. And, as apparent from the Fig. 2, ^(a) ~~with the structure~~ ^{by} ~~of~~ providing the heat separation member 25 on the bottom surface side within the pickup housing 24 ^{such that it is} ~~and being~~ covered on the side surface thereof with a ^{part} ~~member~~ of the pickup housing 24, the housing and the heat separation member can be formed as one unit.

Further, it is also possible to make the space of the slit portion and the recessed gutter formed in the pickup housing 24 in a form of an air layer, ^{rather than} ~~but not~~ filling up the space with the heat separation material 25. In this case, the thermal conductivity of the air is about 0.03 kcal/mh°C, ^{which is} ~~being~~ smaller than that of the material of resin group; therefore, it has a large effect on the heat separation, but the rigidity of the optical pickup 4 is lowered, ^{so that} ~~then~~ the heat separation member 25 will be needed ~~to be~~ ^{to provide adequate rigidity} ~~provided~~ if ~~the rigidity~~ is necessary for the optical pickup 4. Also, if the slit portion and the recessed gutter in the pickup housing 24 are formed ^{to have} ~~in~~ a fin-like structure (i.e., a concave and convex structure), in the case of being filled up with ~~the~~ air ^{an} ~~therein~~ to form ~~the~~ air layer, it is possible to improve ~~an~~ ^{the} effect of heat radiation into ~~an~~ air, remarkably, with the effect of heat separation.

With ^{on} such the structure of the optical pickup 4 ^{having the structure as described} (mentioned) above, the heat generated from the laser diode 27 for CD use is radiated upon the lower side of the pickup housing 24, ^{as seen} in the Figs. 2(a) and 2(b), and ^{it is radiated} (that) from the laser driver circuit board 29 ^{as also seen} (is radiated) upon the upper side of the housing, ^{which is} in the Figs. 2(a) and 2(b). Therefore, it is possible to achieve an effective heat radiation, so that a uniform thermal distribution can be brought about over the pickup housing 24. In this case, on the lower side of the pickup housing 24 ^{being} separated by the heat separation member 25, there are disposed the laser diode 28 for DVD use, and so on, which also generates (the) heat when the apparatus operates, and also on the upper side of the housing, the objective lens driver 26, ^{is provided} etc. However, since they do not have such ^a (the) large amount of heat generation as the laser diode for CD use, and also since the distance between those elements is larger than that between the laser diode 27 for CD use and the laser driver circuit board 29, as well as, in (the) heat radiation volume by means of the pickup housing 24, (therefore) the thermal interference is smaller than that between the laser diode 27 for CD ^{use} and the laser diode driver circuit board 29 for (the) CD use.

In the present embodiment, a portion lies in the pickup housing 24 being formed as one unit, where the laser diode 27 for ^{use} CD and the laser diode 28 for DVD ^{use}, the prism 31, the mirror 30, the lens 33, the optical detector 34, etc., are disposed, and it is not divided into sections by means of the heat separation member 25. ^{Thus,} (then) the thermal deformation of the pickup housing 24 is small, therefore it is possible to make the relative positional shift and/or angular shift (a tilt of the element) between those elements small, thereby to improve the accuracy in the reproducing/recording operation.

According to the present embodiment, it is possible to prevent (the) thermal interference from occurring between the elements provided within the optical pickup 4, therefore it ^{is possible to make} (enables the) effective use of the pickup housing 24 as ^a (the) heat radiation member,

thereby protecting the laser diodes 27 and 28 from deterioration *which leads to reduction of lifespan* on the lifetime due to the heat. With this, it is possible to obtain a disc driving apparatus *which is* being highly reliable and able to achieve *is* the high definition reproducing/recording.

5 Next, explanation will be given on a second embodiment according to the present invention, *will be described with reference* by referring to Figs. 3 and *(a), (b)* 4. *Fig 4(a) to 4(d)* The Figs. 3(a) and 3 (b) show a plane view and a cross-sectional *respectively,* view of an optical pickup in the disc driving apparatus according to the second embodiment, and in particular, the Fig. 3(a) the *(a) to 4(d) are diagrams illustrating* plane view and the Fig. 3(b) the B-B cross-section view in the *1 line* Fig. 3(a). *an* The Fig. 4 *is a view for explaining about* the condition of flow-through within the optical pickup mentioned above. However, in this second embodiment, *an* explanation will be omitted *of those* on a portions duplicating *elements* with those in the first embodiment. Also, in this second *elements* 15 embodiment, the constituent elements commonly provided in the first embodiment achieve the same effects thereof.

The function of the optical pickup 4 is to reproduce or record information on the disc 1. For this reason, in the disc driving apparatus 40 (see the Fig. 1), there is provided a means for shifting or moving the optical pickup 4 to a predetermined position on the disc 1, and as a guide for it, in the side of the apparatus, for example, there is provided a main shaft guide bar 21 *seen in* (the upper side in the Figs. 3(a) and 3(b)) and a secondary shaft guide bar *seen in* (the lower side in the Figs. 3(a) and 3(b)). For supporting the pickup housing 24, *so that it is* (to be) freely slidable in the direction of the guide bars 21, two ((2) pieces of) slide bearings 22 (for the main shaft) are inserted with pressure onto the pickup housing 24, on the side of the main shaft guide bar 21, and on the *seen* side of the secondary shaft guide bar 21, *supports* *the* is formed only one ((1) piece of the) slide bearing 23 *formed* with the housing as one unit. 30

Within an inside of the pickup housing 24, there are provided two ((2)) detection systems for the CD and the DVD, i.e., the parts or elements, such as, the laser diode 27 (of wavelength, 780 nm)

for ~~the~~ CD use and the laser diode 28 (of wavelength, 650 nm) for ~~the~~ DVD use as the detection light source, the mirror 30, the prism 31 and the collimator lens 32 for guiding those detection light ^{beams} ~~upon~~ ^{onto} the disc 1, the optical detector 34 commonly ^{used} for ~~use in~~ the CD and DVD, for detecting the reflection light from the disc 1, the driver circuit board 29 for the laser diode 27 for CD, ^{use} and the driver circuit and the high frequency module for the laser diode 28 for CD, ^{use} and the objective lens driver 26 equipped with the objective lens for determining the detection light on the disc 1 at ~~the~~ ^{position} predetermined ~~position~~ accurately, etc. A mirror 30 is attached on ~~an~~ ^{use} each upper surface of the laser diodes 27 and 28 for CD and DVD, so that the detection light emitted from each of the laser diodes 27 and 28 is ^{reflected} ~~polarized~~ in ~~the~~ an inner direction on the surface of the optical pickup 4. For positioning those parts or elements therein, the pickup housing 24 is formed into ~~the~~ ^a box-like shape with the sidewall 24a and the bottom wall 24b, wherein the laser diode 27 for CD, ^{use} the laser diode 28 for DVD, ^{use} the optical detector 34, etc., are mounted on ^{and attached to} the bottom surface of the housing ~~being attached from the bottom surface side thereof~~, while the other optical parts or elements are mounted within ~~an~~ inside of the housing.

With the present embodiment, the heat separation member 25 is provided in the pickup housing 24 ^{thermally} ~~for separating~~ the laser diode 27 for CD, ^{use} the laser diode 28 for DVD, ^{use} the laser driver circuit board 29 and the objective lens driver 26 ^{each} from ~~the~~ other ~~of~~ ^{thermally} within the ~~inside of the~~ housing, among those mounted elements ^{which produce} ~~accompanying~~ heat generation therein when the apparatus operates. The pickup housing 24 is made of ~~the~~ ^a metal material, such as aluminum, magnesium, zinc, etc. The heat separation member 25 is formed by using ~~the~~ ^a PPC resin (polyphenylene sulfide), polycarbonate, polystyrene, etc. ^{when} In case of taking the strength or rigidity of the pickup housing 24 into the consideration, it is preferable to put in or mix a material ~~of~~ ^{increasing}, such as glass filler, etc., into the material thereof, for ~~rising up~~ the rigidity thereof. The thermal conductivity is about 200 kcal/mh°C for aluminum, about 150

kcal/mh°C for magnesium, about 100 kcal/mh°C for zinc, and 0.2 kcal/mh°C for the material of ^{the} resin group. Therefore, ^{using} ~~putting~~ the heat separation members' 25 ^{reduces the heat flow by as much} ~~enables to make~~ as about 0.001 times ^{compared to} ~~(small as)~~ the thermal flow-through within the pickup housing 24.

5 Further, it is also possible to separate them by making each of the heat separation members only in the form of a slit, thereby thermally separating them by an air layer. In this case, ^{since} the thermal conductivity of the air is about 0.03 kcal/mh°C, being smaller than that of ^a ~~the~~ material of ^{the} resin group, ~~(therefore)~~ it has a large effect on the heat separation. However, since the rigidity of the optical pickup 4 is lowered, ~~(then)~~ the heat separation member 25 will be needed ~~(to be provided)~~ if ~~the~~ ^{further} rigidity is necessary for the optical pickup 4. Also, if the slit portion and the recessed gutter in the pickup housing 24 are formed ^{to have} ~~(in)~~ a fin-like structure 15 (i.e., a concave and convex structure), in the case of being filled up with ~~the~~ air ~~(therein)~~ to form ^{an} ~~the~~ air layer, it is possible to improve ^{the} ~~(an)~~ effect of heat radiation into ^{the} ~~(an)~~ air, remarkably, with the effect of ^{the} heat separation.

Also, as shown in the Fig. 3(b), the heat separation members 20 25 are provided from the bottom surface side of the pickup housing 24, while the side surface thereof is covered with ^{a portion} ~~(the member)~~ of the housing ~~(s)~~, therefore, it is possible to form the pickup housing 24 and the heat separation member 25 together ~~(s)~~ as one unit rigidly. Further, from the ^{point of view} ~~(consideration)~~ of separation from the heat source portion, such ^a ~~(the)~~ structure may be applicable ^{in which} ~~(that)~~ the heat generating-element is attached on the pickup portion as ~~(other)~~ ^{another} element, and thereafter that portion is attached through the heat separation members 25.

In a CD hologram unit ^{formed} ~~(forming)~~ the laser diode 27 for CD, ^{use} and a light detector 34 for the CD system together as an unit, or in a DVD hologram unit ^{formed} ~~(forming)~~ the laser diode 28 for DVD, ^{use} and a light detector 34 for the DVD system together as an unit, the provision

of the heat separation member 25 between those elements enables protection [thereof] from [the] thermal interference between them, and further, since no shifting of the detection light occurs on the optical detector 34 as far as no deformation is caused in the hologram unit portion, even when the housing portion is deformed due to a partial deformation by the heat separation member 25, (therefore) it is possible to realize ^{an} [the] optical pickup 4 having high reliability.

In the present embodiment, further, because ^{use} of the structure ^{of the structure} of the box-like shape, wherein the laser diode 27 for CD, the laser diode 28 for DVD, and the optical detector 34 are provided on the bottom wall of the pickup housing 24, thereby surrounding the optical pickup 4 ^{with} ^{thereby} the side walls in every direction [thereof], (therefore) it is possible to improve the rigidity of the pickup housing 24 remarkably. For example, improvements can be obtained ^{bending} on the rigidity of the pickup housing 24 against [bent] and/or twist, and on the vibration characteristics due to local deformation, or the like, and also relative positional shifting and/or angular shifting between the optical elements due to the deformation in the static pickup housing 24 can be suppressed.

^{this} According to [those] embodiment, it is possible to protect the elements from [the] thermal interference between them, thereby protecting those elements from deterioration ^{which leads to reduction in} on the lifetime thereof. With this, it is possible to provide ^{an} [the] optical pickup 4 having high reliability. Also, an improvement can be obtained ^{an} on the reliability ^{employed} (with) the disc driving apparatus, in which such [the] optical pickup is [applied].

Next, by referring to Figs. 4(a) to 4(d), ^{an} explanation will be given on the structure, for the heat flow-through (arrows in the figure indicate the heat flows within the optical pickup housing members) and [for] thermal separation within the pickup housing 24, ^{an} along with the functions and effects thereof. Herein, [the] explanation is given ^{where} on the case, assuming that the heat-generating elements

within the optical pickup 4 are the laser diode 27 for CD^{use}, the laser diode for DVD^{use}, the laser driver circuit board 29 for the CD and the driver coil equipped with the objective lens driver 26, as shown in the ^{drawing} figure.

5 Fig. 4(a) shows the thermal flow-through (the flow of heat ^{from members} within the optical pickup housing ^{an} member 5) from the heat-generating elements when operating within (the) optical pickup 4, but having no thermal separation structure therein. In general, ^{the} an output of the laser diode 27 or 28 ^{becomes} comes to be very large when recording information on the disc 1, comparing ^{ed} to the case of reproducing information on the disc 1. In the case of (the) DVD-ROM corresponding to (the) CD-R/RW ^{device}, the laser diode 28 for DVD ^{use} is only for (the use ^{used} of) reproducing ^{recorded information}, exclusively; however, the laser diode 27 for CD ^{use} is used for both (the) recording/reproducing, ^{and} therefore, the heat generation from the laser diode 27 is large, in particular when recording. Also, the laser driver circuit board 29 provided within the housing is electrically connected with the laser diode 27, ^{so} and they should be disposed ^{close} (neighboring) to each other ^{from the point of view of} (by) taking noises and unnecessary radiation into the consideration. For this reason, (the) thermal interference occurs due to the mutual heat generation between the laser diode 27 for CD ^{use} and the laser driver circuit 19 for the CD, ^{so} (and) that portion comes to be (the) ^{an} condition of being saturated thermally. Thus, it results in ^{an increase in the} (the rise-up) ^{use} of temperature of a portion of the laser diode 27, thereby bringing about ^a (the) deterioration ^{leading to reduction in} of the lifetime of the laser diode 27 and/or malfunctions on the laser driver circuit board or each of the circuit boards provided with the apparatus. Also, (the) thermal interference occurs due to heat radiation from the laser diode 28 for DVD ^{use} and the driver coil equipped within the objective lens driver 26, participating with the other heat-generating elements, and it causes (the) thermal deformation ^{of} (on) the housing through thermal distribution within the pickup housing 24, etc. The thermal deformation of the housing brings about (the) ^a relative optional shifting and (the) angular shifting, etc., between the optical elements, thereby causing deterioration ^{of} (on) the optical

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characteristics (i.e., ^athe shifting of the optical axis, and ^athe positional shifting of ^aan optic point on the optical detector).

Fig. 4(b) shows a principal idea of the present invention, in which each of the heat-generating elements is separated within ^{individual spaces} ⁵ ~~the~~ inside of the optical pickup 4, and the heat separation members 25 are provided for separating those heat-generating elements, respectively. With ^{provision of} those heat separation members 25, ^{which are} ~~being~~ made of ^a ~~the~~ material ^{having a} ~~being~~ smaller ^{in the} thermal conductivity than that of the housing, ^{good} ~~the~~ thermal separation can be obtained. Also, ¹⁰ with ~~determining~~ the volume of the housing portion, ^{being defined} by enclosing ^{respective heat-generating elements} with the heat separation members 25, ^{in individual spaces whose sizes} ~~depend~~ ^{each} upon the heat generation amount of ^a ~~the~~ heat-generating element, it is possible to bring the pickup housing 24 as a whole into ^a ~~the~~ condition of ^{having an} ~~being~~ almost uniform ^{a localized} ~~in the~~ thermal distribution therein. ~~With~~ ¹⁵ this, ^{way} ~~the local~~ heat distribution can be eliminated, so that the housing can be reduced down in temperature as a whole.

Fig. 4(c) shows a variation of the heat separation member 25 provided within the optical pickup 4. The heat separation member 25 is disposed in the present variation, so that the laser diode ²⁰ 27 for ^{use} CD, and the laser driver circuit board 29 for the CD are separated from each other. Also, this heat separation member 25 is further elongated ^{so} as to separate the laser diode 28 for DVD ^{use} from the objective lens driver 26 ^{in the structure thereof}. With such ^a ~~the~~ structure ^{according to} of the present variation, as was mentioned ²⁵ ~~in the~~ above, the heat separation member 25 is provided for separating ^{between} the laser diode 27 for ^{use} CD, having the largest heat generation amount, and the laser driver circuit board 29 for the CD, thermally, thereby protecting them from ~~the~~ thermal interference therebetween, and the heat flow from ~~the~~ each element ³⁰ is ^{directed} ~~detected~~ in the direction ^{away from} opposite to the heat separation member 25, thereby ^{making it possible} ~~enabling~~ to use the pickup housing 24 ^{effectively} ~~as the~~ heat radiation member ^a ~~effectively~~. In this case, ^{use} ~~the~~ thermal interference between the laser diode 27 for CD, and the laser diode 28 for DVD, ^{use} or between the laser driver circuit board 29 for CD, ^{use}

and the objective lens driver 26 is small, ^{according to} [from] the positional relationships between the heat generation amount from the respective elements and the distance between them (or, the cross-section ^{of the} area [] through which the heat conducts).

5 Also, the structure of the variation ^{described above} mentioned herein is effective, in particular, in the case where it is applied ~~to~~ to an optical system having ^a [the] CD system or ^a [the] DVD system, wherein the optical elements, such as, the laser diodes 27 and 28, the optical detector 34, the prism 31 for guiding detection light from
10 the laser diode 27 or 28 onto the objective lens of the objective lens driver 26 [], so as to be irradiated upon the disc 1 at the predetermined position thereof [] and for guiding the reflection light from the disc 1 back to the optical detector 34, the mirror 30, the lens 33, etc., are installed in the form of separate elements,
15 respectively. This is [] because the deformation ^{does not easily occur} [is difficult to] ^{(be formed,]} when ^{(the]} thermal deformation is caused in the pickup housing 24 due to the heat radiation from ^{(the]} each heat-source element, or when ^{(the]} vibration characteristic (bent mode, twist mode, local deformation mode) is caused due to the rigidity of
20 the portion of the pickup housing 24, since the portion where the optical elements are installed is formed as one unit (no provision of the heat separation member 25). If ^a [the] material of the resin group or the like is used for the heat separation member 25, the stress accompanying ^{(with]} the deformation is concentrated on this
25 heat separation member 25, thereby relieving the stress ^{at} [on] the portion where the optical elements are attached in advance [], and) therefore, it has an effect to suppress the deformation.

Fig. 4(d) shows ^a [the] C-C cross-section of the optical pickup 4 shown in ^{(the]} Fig. 4(c). As apparent from this figure, the laser
30 diode 27 for CD ^{is} provided with ^a cut-out portion ^{provided in} (from) the bottom surface of the ^{(portion of the]} pickup housing 24, so as to be disposed at ^a [the] predetermined position [], thereby to be attached to []. The laser driver circuit board 29 for the CD is attached onto the bottom surface of the pickup housing 24. The heat separation member 25

is provided between those two (2) elements; however, according to the present variation, with provision of a groove-like cut-out on the bottom surface of the pickup housing 24, the heat separation member 25, being made of material ^{having a} ~~being~~ smaller ^(in the) thermal conductivity than that used for the housing, is inserted into this groove portion. Of course, it may be formed with the pickup housing 24 as one unit. Arrows shown in the figure indicate the heat flows from the heat-generating elements. Since the cross-section ^{al} area of the housing portion between the elements (i.e., between the laser diode 27 for CD ^{use} and the laser driver circuit board 29 for the CD use) ^{used} ~~(comes to be small)~~ ^{is small} for the heat separation member 25, the heat amount flowing through this cross-section also ~~(comes down)~~ ^{comes down} ~~(to be)~~ ^{is} small, thereby enabling ^a ~~(the)~~ thermal cut-off between the elements. As a result of this, it is possible to protect the elements from ~~(the)~~ thermal interference therebetween. Herein, ^{a small part of} the cross-section ^{al} area ^{this} ~~(is remained a little bit)~~ ^{remains} between the elements, but since ^{this} ~~(it)~~ is for ~~(the)~~ forming ^{as} one unit, ^{providing} ~~(therefore)~~ it is also possible to completely cut-off ^{heat flow} by the heat separation member 25 between them.

20 In each of those embodiments mentioned above, the heat separation member(s) 25 is/are provided in a straight line-like manner; however, the heat separation member(s) 25 may be provided with a curved portion, a deleted portion therein, or ^{they} ~~may~~ ^{be in} have such ~~(the)~~ ^a structure that the cross-section ^{al} area is changed in a portion thereof.

According to each of ^{the} ~~those~~ ^{described} ~~embodiments~~ ~~(mentioned)~~ above, with the provision of the heat separation member(s) 25 within the optical pickup 4, it is possible to separate the elements, such as ~~(the)~~ the laser diode 29 and the laser driver circuit board 29, etc., ^{which} generate ^e ~~heat~~ heat when reproducing information on the disc 1 or when recording the information on it, thermally within the pickup housing 24; therefore, it is possible to protect those elements 27 and 29 from ~~(the)~~ thermal interference ~~(therebetween)~~. ⁱⁿ ~~(With)~~ ^{way} this, each of those heat-generating elements 27 and 29, being disposed

^{closely}
[to be] adjacent to each other, is able to radiate [the] heat stably,
without having [the heat] radiation effects from the other elements^{to bear heat};
therefore, it is possible to protect it from [the] deterioration^{leading to reduction in} [on]
the lifetime thereof. Also, with provision of the heat separation
5 member 25, by taking the heat generation amount of the
heat-generating elements 26 to 29 and the heat radiation volume
in the housing members into the consideration, it is possible to
obtain [the] ^auniform change in temperature ^{within} [of] the pickup housing
24, thereby ^{protecting} [enabling the protection of] the pickup housing 24 from
10 [the] thermal deformation due to the local temperature distribution
thereon. As a result [of this], the detection light ^{beam} emitted from
the laser diode 27 or 28 is guided onto the disc 1, and [it is prevented]
[from the] ^arelative positional shift and/or the shift in inclination,
etc., within the optical elements, such as, the prism, the mirror,
15 the lens, etc., for guiding the reflection light from the disc
1 onto the optical detector 34. In the disc driving apparatus using
such [the] ^{an}optical pickup, it is possible to protect the circuits
from [the] ^amalfunction thereof, and also obtain an improvement [on] ^{an}
the reliability of the apparatus, thereby providing [the] ^adisc
20 driving apparatus ^{capable of} [with the] high definition.

As was fully explained [in the] above, according to the present
invention, it is possible to reduce the thermal interference
between the heat-generating elements disposed [to be] adjacent to
each other in the optical pickup, so as to prevent the
25 heat-generating elements from being deteriorated ^{leading to a reduction in} (in) the lifetime
thereof, thereby obtaining [the] ^adisc driving apparatus having ^ahigh
reliability.

Also, according to the present invention, it is possible to
reduce the thermal interference between the heat-generating
30 elements disposed [to be] adjacent to each other in the optical pickup,
so as to prevent the heat-generating elements from being
deteriorated ^{leading to a reduction in} in the lifetime thereof, and also to make the shifting
of the detection light small, so as to improve the accuracy in
the operation of reproducing or reproducing/recording, thereby

obtaining ^athe disc driving apparatus having ^ahigh reliability and
being ^{which is} capable of ^athe high definition reproducing or
reproducing/recording.

Further, according to the present invention, it is possible
5 to reduce the thermal interference between the heat-generating
elements disposed ^ato be adjacent to each other in the optical pickup,
so as to prevent the heat-generating elements from being
deteriorated ^{leading to a reduction} in the lifetime thereof, and also to maintain the
strength of the pickup housing, so as to improve the accuracy in
10 the operation of reproducing or reproducing/recording, thereby
obtaining ^athe disc driving apparatus having ^ahigh reliability and
being ^{which is} capable of ^athe high definition reproducing or
reproducing/recording.

What is claimed is:

1. A disc driving apparatus, comprising:

a housing of a disc drive;

a rotation mechanism ^{disposed} [being received] within said housing
5 [and] for rotating a disc;

an optical pickup mechanism ^{disposed} [being received] within said
housing [and] for reproducing or reproducing/recording [of]
information on the disc; wherein:

said optical pickup mechanism has an optical pickup and
10 a driving mechanism for driving said optical pickup in ^a radial
direction of said disc;

said optical pickup comprises a pickup housing made of metal,
in which are mounted a laser diode emitting [a] detection light for
reproducing or recording [the] information on said disc, a laser
15 driver circuit board for controlling said laser diode, an objective
lens driver for guiding the detection light emitted from/to a
predetermined position on said disc and for guiding reflection
light from said disc onto an optical detector, optical parts [,
including a lens, a prism, a mirror [therein], and an optical detector
20 for detecting said detection light; and

[said pickup housing mounts] said laser diode and said laser
^{are mounted in thermal contact} driver circuit board with ^{said pickup housing so as} connecting them thermally, to be disposed
[in] adjacent ^{to} [with] each other, while providing a thermal separation
portion for thermally separating [between] said laser diode and said
25 laser driver circuit board.

2. A disc driving apparatus as defined in the claim 1, wherein
said thermal separation portion comprises a dividing portion formed

with either one of a slit portion or a recess gutter, for dividing said pickup housing, disposed between said laser diode and said laser driver circuit board, and a heat separation member disposed in said dividing portion.

5 3. A disc driving apparatus as defined in the claim 2, wherein said pickup housing is made of metal material having good thermal conductivity, [including aluminum, magnesium, zinc,] and said thermal separation portion is formed by filling resin material into the separation portion of said pickup housing, thereby to
10 form them in one body.

4. A disc driving apparatus, comprising:

a housing of a disc drive;

a rotation mechanism ^{disposed} [being received] within said housing
[and] for rotating a disc;

15 an optical pickup mechanism ^{disposed} [being received] within said housing [and] for reproducing or reproducing/recording [of] information on the disc[;], wherein[;]

said optical pickup mechanism has an optical pickup and a driving mechanism for driving said optical pickup in^a radial
20 direction of said disc;

said optical pickup comprises a pickup housing made of metal, in which are mounted a laser diode for emitting (a) detection light for use ^{with} (of) a CD, so as to reproduce or record [the] information on said disc, a laser diode for emitting a detection light for use ^{with} (of) a DVD, so as to reproduce or record [the] information on said
25 disc, a laser driver circuit board for controlling said laser diode for use ^{with a} [of the] CD, an objective lens driver for guiding the detection light emitted from/to a predetermined position on said disc and for guiding reflection light from said disc onto an optical detector,

optical parts[,] including a lens, a prism, a mirror [therein], and an optical detector for detecting said detection light; and

[said pickup housing mounts] said laser diode for use ^{with a} of the CD, said laser diode for use ^{with a} of the DVD, said laser driver circuit ^{are mounted in thermal contact} board and said objective lens driver[,] with ^{with a} connecting them ^{to} (thermally), wherein said laser diode for use [of the] CD and said laser driver circuit board are disposed (in) adjacent ^{and} with each other, (while providing) ^{an area occupied by} a thermal separation portion ^{is provided} for thermally separating [between a side of] said laser diodes for use ^{with a} of the CD and [the] DVD and ^{an area occupied by} a side of said laser driver circuit board and said objective lens driver ^{within said pickup housing}.

5. A disc driving apparatus as defined in the claim 4, wherein the prism and the mirror of said optical portions and said optical detector are disposed (on a side being) nearer to said laser diodes for use ^{with a} of the CD and ^{to} (the) DVD than said thermal separation portion.

6. A disc driving apparatus as defined in the claim 4, wherein said thermal separation portion is provided[,] so as ^{thermally} to separate either one of between said laser diode for use of the CD and said laser diode for use of the DVD, and between said laser driver circuit board and said objective lens driver[, thermally].

7. A disc driving apparatus, comprising:

a housing of a disc drive;

a rotation mechanism ^{disposed} (being received) within said housing (and) for rotating a disc;

25 an optical pickup mechanism ^{disposed} (being received) within said housing (and) for reproducing or reproducing/recording (of) information on the disc[]; wherein[]

said optical pickup mechanism has an optical pickup and

a driving mechanism for driving said optical pickup in radial direction of said disc;

said optical pickup comprises a pickup housing made of metal, in which are mounted a laser diode for emitting [a] detection light for use ^{with} [of] a CD, so as to reproduce or record the information on said disc, a laser diode for emitting [a] detection light for use ^{with} [of] a DVD, so as to reproduce or record [the] information on said disc, a laser driver circuit board for controlling said laser diode for use ^{with a} [of the] CD, an objective lens driver for guiding the detection light emitted to a predetermined position on said disc and for guiding reflection light from said disc onto an optical detector, optical parts [] including a lens, a prism, a mirror [therein], and an optical detector for detecting said detection light; and

said pickup housing is defined by a sidewall formed all around ^{the periphery} thereof and a bottom wall, and said laser diodes for use ^{with a} [of the] CD and ^a [the] DVD, said laser driver circuit board and said objective lens driver are mounted therein ^{in thermal contact} [] with ^{said pickup housing} (thermally) ^{with a} connecting thereamong, wherein said laser diode for use ^{so as to be} [of the] CD and said laser driver circuit board are disposed ^{and} (in) adjacent ^{is provided} [] with each other, ^{an area occupied by} while providing a thermal separation portion for thermally separating ^{an area occupied by} [between a side of] said laser diodes for use ^{with a} [of the] CD and ^a [the] DVD and ^{an area occupied by} [a side of] said laser driver circuit board and said objective lens driver ^{within said pickup housing}.

8. An optical pickup, comprising:

a laser diode for emitting [a] detection light, so as to reproduce or record information on a disc;

a laser driver circuit board for controlling said laser diode;

an objective lens driver for guiding the detection light emitted from to a predetermined position on said disc and for guiding

reflection light from said disc onto an optical detector;

optical parts^(,) including a lens, a prism^(therein), ^{and} a mirror^(therein); [and]

an optical detector for detecting said detection light;

5 and

a pickup housing made of metal material, in which said above-mentioned ^{elements} are mounted^(,) wherein^(:)

[said pickup housing mounts] said laser diode and said laser driver circuit board ^{are mounted in thermal contact} with ^{connecting them thermally} ^{said pickup housing so as} to be disposed ^{and} in adjacent ^{to} ^{is provided} ^{within said pickup housing} with each other, (while providing a thermal separation portion for thermally separating ^{between} said laser diode and said laser driver circuit board.

9. An optical pickup, comprising:

15 a laser diode for emitting (a) detection light, so as to reproduce or record information on a disc; ^{for use with a CD}
^{a laser diode for emitting detection light, so as to reproduce information on a disc; for use with a DVD;}
a laser driver circuit board for controlling said laser diode; ^{for use with a CD}

20 an objective lens driver for guiding the detection light emitted from/to a predetermined position on said disc and for guiding reflection light from said disc onto an optical detector;

optical parts^(,) including a lens, a prism^(therein), ^{and} a mirror^(therein); [and]

an optical detector for detecting said detection light;

and

25 a pickup housing made of metal material, in which said

above-mentioned ^{elements} are mounted ⁽²⁾; wherein ⁽³⁾

[said pickup housing mounts] said laser diode for use ^{with a} [of the] CD, said laser diode for use ^{with a} [of the] DVD, said laser driver circuit board and said objective lens driver ^{as mounted in thermal contact} (1) with ^{with a} [connecting them] ^{to} thermally, wherein said laser diode for use [of the] CD and said laser driver circuit board are disposed ^{and} (in) adjacent ^{is provided} (with) each other, ^{an area occupied by} (while providing) a thermal separation portion, for thermally separating ^{an area occupied by} (between a side of) said laser diodes for use ^{with a} (of the) CD and ^a (the) DVD and ^{an area occupied by} (a side of) said laser driver circuit board and said
10 objective lens driver.

ABSTRACT OF DISCLOSURE

In a disc driving apparatus, wherein a laser diode [27] and a laser driver circuit board [29] are mounted on a pickup housing [24], being connected with thermally ^{are} disposed adjacent ^{to} each other, [and] a heat separation member [25] is provided between the laser diode [27] and the laser driver circuit board [29] for ^{effecting} thermal separation therebetween, thereby reducing the thermal interference between the heat-generating elements ^{that are} [disposed to be adjacent ^{to each other} in the optical pickup] so as ^{This makes it possible} to protect the heat-generating elements from being deteriorated ^{leading to a reduction in the} [on] lifetime thereof, as well as, ^{to} improve the reliability thereof.